

What is claimed is:

1. A brake module comprising:

a first circuit of pressurized brake fluid;

5 a second circuit of pressurized brake fluid;

a third circuit of pressurized brake fluid;

a first set of brake actuators operated by the application of pressurized brake fluid;

10 a second set of brake actuators operated by the application of pressurized brake fluid;

a first fluid separator unit coupled to said first circuit and said second circuit for substantially preventing the intermixing of pressurized brake fluid between said first circuit and said second circuit, said first fluid separator unit having a moveable pressure boundary which enables, through movement thereof, said second circuit of pressurized brake fluid to selectively act upon said first brake actuator in response to said first circuit of pressurized brake fluid acting upon said first fluid separator unit; and

20 a second fluid separator unit coupled to said first circuit and said third circuit for substantially preventing the intermixing of pressurized brake fluid of said first circuit and said third circuit, said second fluid separator unit having a moveable pressure boundary which enables, through movement thereof, said third circuit of pressurized brake fluid to selectively act upon said second brake actuator in response to said first circuit of pressurized brake fluid acting upon said second fluid separator unit;

25 wherein said first circuit includes at least one proportional valve for selectively controlling said pressurized brake fluid of first circuit acting on said first and said second fluid separator units.

2. The brake module of claim 1 wherein said at least one proportional valve
30 comprises a single three-way proportional valve.

3. The brake module of claim 1 wherein said at least one proportional valve includes four proportional valves, wherein a first proportional valve and a second proportional valve are open and closeable to provide pressurized brake fluid from said first circuit to selectively act upon said first and second fluid separator units, wherein a
5 third proportional valve and a fourth proportional valve are open and closeable to relieve said pressurized brake fluid from acting on said first and second fluid separator units.

4. The brake module of claim 3 wherein said first proportional valve and
10 said third proportional valve are fluidically connected to said first fluid separator unit to provide said pressurized brake fluid from said first circuit to selectively act on said first fluid separator unit, wherein said second proportional valve and said fourth proportional valve are fluidically connected to said second fluid separator unit to provide said pressurized brake fluid from said first circuit to selectively act on said
15 second fluid separator unit.

5. The brake module of claim 4 wherein said four proportional valves comprise two-way proportional valves.

6. The brake module of claim 5 wherein said first and second proportional valves are two-way normally closed valves and said third and said fourth proportional valves are two-way normal open valves.

7. The brake module of claim 6 further comprising a compliance
25 accumulator, said compliance accumulator maintains a pressure exerted within the first circuit in response to a differential actuation of said first, second, third, and fourth proportional valves and valves of a second brake module.

8. The brake module of claim 1 wherein said at least one proportional valve
30 includes a plurality of proportional valves, wherein a first predetermined number of proportional valves are open and closeable to provide pressurized braking fluid from said first circuit to selectively act upon said first and second fluid separator units,

wherein a second predetermined number of proportional valves equal to said first predetermined number of proportional valves are open and closeable to relieve said pressurized braking fluid from acting on said first and second fluid separator units.

9. A vehicle braking system comprising:

a brake module, said brake module comprising:

a first circuit of pressurized brake fluid;

a second circuit of pressurized brake fluid;

a third circuit of pressurized brake fluid;

a first set of brake actuators operated by the application of pressurized brake fluid;

a second set of brake actuators operated by the application of pressurized brake fluid;

a first fluid separator unit coupled to said first circuit and said second circuit for substantially preventing the intermixing of pressurized brake fluid between said first circuit and said second circuit, said first fluid separator unit having a moveable pressure boundary which enables, through movement thereof, said second circuit of pressurized brake fluid to selectively act upon said first set of brake actuators in response to said first circuit of pressurized brake fluid acting upon said first fluid separator unit;

a second fluid separator unit coupled to said first circuit and said third circuit for substantially preventing the intermixing of pressurized brake fluid of said first circuit and said third circuit, said second fluid separator unit having a moveable pressure boundary which enables, through movement thereof, said third circuit of pressurized brake fluid to selectively act upon said second set of brake actuators in response to said first circuit of pressurized brake fluid acting upon said second fluid separator unit;

wherein said first circuit includes at least one proportional valve for selectively controlling said pressurized brake fluid of said first circuit acting on said first and said second fluid separator units; and

a second brake module wherein said brake module and said second brake module cooperatively apply a braking torque to said first set and said second set of brake actuators.

5 10. The vehicle braking system of claim 9 wherein said second brake module comprises an anti-lock braking module.

 11. The vehicle braking system of claim 9 wherein said second brake module comprises a traction control module.

10 12. The vehicle braking system of claim 9 wherein said second brake module comprises a vehicle stability control module.

 13. The vehicle braking system of claim 9 wherein said at least one
15 proportional valve comprises a single three-way proportional valve.

 14. The vehicle braking system of claim 9 wherein said at least one proportional valve includes four proportional valves, wherein a first proportional valve and a second proportional valve are open and closeable to provide pressurized brake
20 fluid from said first circuit to selectively act upon said first and second fluid separator units, wherein a third proportional valve and a fourth proportional valve are open and closeable to relieve said pressurized brake fluid from acting on said first and second fluid separator units.

25 15. The vehicle braking system of claim 14 wherein said first proportional valve and said third proportional valve are fluidically connected to said first fluid separator unit to provide said pressurized brake fluid from said first circuit to selectively act on said first fluid separator unit, wherein said second proportional valve and said fourth proportional valve are fluidically connected to said second fluid
30 separator unit to provide said pressurized brake fluid from said first circuit to selectively act on said second fluid separator unit.

16. The vehicle braking system of claim 15 wherein said four proportional valves comprise two-way proportional valves.

17. The vehicle braking system of claim 16 wherein said first and second
5 proportional valves are two-way normally closed valves and said third and said fourth proportional valves are two-way normal open valves.

18. The vehicle braking system of claim 9 further comprising a compliance accumulator, said compliance accumulator maintains a pressure exerted within said
10 first circuit in response to a differential actuation of said first, second, third and fourth proportional valves and valves of said second brake module.

19. The vehicle braking system of claim 9 wherein said brake module further comprises a first relief valve for alleviating over-pressurization of brake fluid
15 within said second circuit and a second relief valve for alleviating over-pressurization of brake fluid within said third circuit.

20. The vehicle braking system of claim 19 wherein said first relief valve is integrated within said first fluid separator unit and said second relief valve is
20 integrated within said second fluid separator unit.

21. The vehicle braking system of claim 9 wherein said second brake module comprises a first relief valve for alleviating over-pressurization of brake fluid within said second circuit and a second relief valve for alleviating over-pressurization
25 of brake fluid within said third circuit.

22. The vehicle braking system of claim 9 wherein said second brake module further comprises a first isolation valve for alleviating over-pressurization of brake fluid within said second circuit and a second isolation valve for alleviating over-
30 pressurization of brake fluid within said third circuit.

23. The vehicle braking system of claim 22 wherein said first isolation valve diverts said brake fluid into said first brake actuator.

24. The vehicle braking system of claim 22 wherein said second brake
5 module further comprises a first low pressure accumulator for storing brake fluid in response to said over-pressurization of brake fluid in said second circuit.

25. The vehicle braking system of claim 24 wherein said second brake
10 module further comprises a first dump valve, said first dump valve diverts said brake fluid into said first low pressure accumulator.

26. The vehicle braking system of claim 23 wherein said second brake
module includes a first relief valve in parallel with said first isolation valve for
diverting said brake fluid into said first brake actuator in response to said over-
15 pressurization of brake fluid in said second circuit.

27. The vehicle braking system of claim 22 wherein said second isolation
valve diverts said brake fluid into said second brake actuator.

28. The vehicle braking system of claim 22 wherein said second brake
20 module further comprises a second low pressure accumulator for storing brake fluid in response to said over-pressurization of brake fluid in said third circuit.

29. The vehicle braking system of claim 28 wherein said second brake
25 module further comprises a second dump valve, said second dump valve diverts said brake fluid into said second low pressure accumulator.

30. The vehicle braking system of claim 22 wherein said second brake
module includes a second relief valve in parallel with said second isolation valve for
diverting said brake fluid into said second brake actuator in response to said over-
30 pressurization of brake fluid in said third circuit.

31. A vehicle braking system for cooperatively applying a portion a braking torque in a regenerative braking system, said brake module comprising comprising:
a brake module, said brake module comprising:
a first circuit of pressurized brake fluid;
5 a second circuit of pressurized brake fluid;
a third circuit of pressurized brake fluid;
a first set of brake actuators operated by the application of pressurized brake fluid;
a second set of brake actuators operated by the application of pressurized
10 brake fluid;
a first fluid separator unit coupled to said first circuit and said second circuit for substantially preventing the intermixing of pressurized brake fluid between said first circuit and said second circuit, said first fluid separator unit having a moveable pressure boundary which enables, through movement
15 thereof, said second circuit of pressurized brake fluid to selectively act upon said first brake actuator in response to said first circuit of pressurized brake fluid acting upon said first fluid separator unit;
a second fluid separator unit coupled to said first circuit and said third circuit for substantially preventing the intermixing of pressurized brake fluid of
20 said first circuit and said third circuit, said second fluid separator unit having a moveable pressure boundary which enables, through movement thereof, said third circuit of pressurized brake fluid to selectively act upon said second brake actuator in response to said first circuit of pressurized brake fluid acting upon said second fluid separator unit;
25 wherein said first circuit includes at least one proportional valve for selectively controlling said pressurized brake fluid of said first circuit acting on said first and said second fluid separator units;
a second brake module wherein said brake module and said second brake module cooperatively apply a braking torque to said first set and said second set of
30 brake actuators; and
a control module for receiving sensed signals and controlling operations of said brake module.

32. The braking system of claim 31 wherein said control module controls operations of said second brake module.

5 33. The braking system of claim 31 further comprising a second control module for controlling operations of said second brake module, said second control module is communicable with said first control module for providing braking torque to said vehicle.

10 34. The braking system of claim 33 further comprising a powertrain control module for controlling a regenerative braking portion of the vehicle, said powertrain control module is in communication with said control module and said second control module for cooperatively controlling braking torque to said vehicle.